Syracuse Lake Aquatic Vegetation Management Plan Prepared for the Syracuse Lake Association

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Funded by the Lake and River Enhancement (LARE) program and the Syracuse Lake Association.

Executive Summary

Aquatic Weed Control was contracted by the Syracuse Lake Association to develop a long term lake wide management plan. Funding for this was provided by the Syracuse Lake Association and the Department of Natural Resources Division of Soil Conservation. This funding was part of the Lake and River Enhancement (LARE) program. This survey and lake management plan is a requirement for receiving state funding to treat the lake for nuisance exotic vegetation.

Syracuse Lake has exotic vegetation that threatens the lake's biodiversity and causes problems with fishing, swimming, boating and the overall use of the lake by residents and non-residents. This report recommends a chemical treatment with the herbicide 2, 4-D to control Eurasian milfoil and kill its roots. Based upon survey data, select areas will be treated to manage the Eurasian milfoil and prevent its spread to other areas of the lake. In all, approximately 35 acres of the lake would be treated for Eurasian milfoil over a three year period with a cost of approximately $7,000 annually for the first two years. In addition to these costs, a pretreatment vegetation survey is required by the IDNR and will cost $1,600 in 2005. Costs in the third year may be dependant upon the level of control achieved by the first two treatments. Additional plant surveys may be required by the IDNR to evaluate the impact that the chemical treatments are having on both Eurasian milfoil and other native species. These additional surveys would cost approximately $1,600 dollars, and funding may be awarded by the LARE program to complete them.

Purple loosestrife is another invasive plant species threatening wetlands around the lake, particularly in the southeast portion, between Syracuse Lake and Lake Wawasee. Trichophr is recommended to control the purple loosestrife. This herbicide has demonstrated the ability to control purple loosestrife in the past, and it will not harm cattails growing in close proximity to the purple loosestrife. The estimated cost for purple loosestrife treatments is 1,500 dollars annually over a three year period. After three years, the amount of purple loosestrife control can be evaluated to update the management strategy.

The top priorities in this management plan are to provide control of invasive species without harming beneficial native plants. By providing this control, the goals of maintaining biodiversity and increasing recreational opportunity at Syracuse Lake can be accomplished.

Cost Summary for Invasive Plant Control in Syracuse Lake

2005

Pretreatment aquatic vegetation survey (required by IDNR)	$1,600.00
Chemically treat 35 acres of Eurasian milfoil in the lake	$7,000.00
August vegetation survey and plan update	$1,600.00
Purple loosestrife herbicide and application costs	$1,500.00

2006

Chemically treat 35 acres of Eurasian milfoil in the lake	$7,000.00
August vegetation survey and action plan update	$1,600.00
Purple loosestrife herbicide and application costs	$1,500.00

2007

Chemically treat areas of Eurasian milfoil re-growth identified by vegetation surveys	$5,000 - $7,000
Purple loosestrife herbicide and application costs	$1500.00

Further costs will be dependant upon the success of the action plan. It is difficult to speculate on costs beyond 2007. Eurasian milfoil should be readily controlled with these chemical treatments and maintenance costs after 2007 should be reduced. Purple loosestrife control costs will also depend on re-growth and the size of the treatment area in years to come.

Acknowledgements

Aquatic vegetation surveys conducted on Syracuse Lake were made possible by funding from the Indiana Department of Natural Resources and the Syracuse Lake Association. Aquatic Weed Control would like to extend special thanks to Indiana Department of Natural Resources (IDNR) District 3 biologist Jed Pearson for providing procedural training for both Tier I and Tier II aquatic vegetation surveys. Jed Pearson also provided assistance and consultation in generating plant distribution maps for Syracuse Lake. Cecil Rich, aquatic biologist for the IDNR Division of Soil Conservation provided valuable consultation regarding the requirements and objectives of this lake management plan. Jed Pearson and Cecil Rich both reviewed this management plan and provided suggestions for revision. Also, special thanks to Brad Fink, assistant fisheries biologist for the IDNR, for providing training in data analysis programs and Jason Doll of the IDNR for providing assistance in generating data analysis reports for the tier II quantitative vegetation surveys. Jim Donahoe and David Keister of Aquatic Weed Control performed the aquatic vegetation sampling and are the authors of this report. Aquatic Weed Control would also like to thank the members of the Syracuse Lake Association for their commitment to improving this lake and for valuable discussion and input brought forward at the informational meeting held on October 12, 2004.

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Introduction

Aquatic Weed Control was contracted by the Syracuse Lake Association to develop a long-term lake-wide management plan. Funding for this report was provided by the Syracuse Lake Association and the Department of Natural Resources Division of Soil Conservation. This funding was part of the Lake and River Enhancement (LARE) program.

When a person registers a boat within the state of Indiana a lake enhancement fee is included in the cost of registry. One third of this money is then used to provide funding for projects designed to improve the quality of Indiana lakes by controlling invasive plant species.

The surveys included in this report, as well as the management plan, are required by the state to receive additional funding to treat the lake for exotic aquatic vegetation. Should a lake be selected for LARE funding, up to 100,000 dollars can be given for a whole-lake treatment with a cumulative 3-year maintenance total of an additional 20,000 dollars. If the whole lake is not treated, up to 20,000 dollars can be available annually for up to three years. Requests for funding are reviewed by the Indiana Soil Conservation Board, and funds will be distributed at their discretion.

This project was initiated to take a more aggressive approach to controlling Eurasian milfoil in the lake, as well as the purple loosestrife located in wetlands near the southeast corner of Syracuse Lake. Eurasian milfoil grows in large bands near the deep edge of the littoral zone in many areas of the lake. Although individual lots have been managed for Eurasian milfoil, the action plan outlined in this report should provide better control over this invasive species, for a longer period of time.

Problem Statement

Syracuse Lake, located in northern Kosciusko County, is in need of intervention to protect its extremely diverse plant community from the invasive aquatic plant Eurasian water milfoil. Eurasian milfoil, while not overly abundant, is present in the lake and has the potential to devastate Syracuse Lake’s ecosystem while severely inhibiting recreational opportunities on the lake.

Eurasian milfoil is of primary concern because of its aggressive nature and its destructive effects on lake ecosystems. This nuisance species grows and spreads rapidly, forming dense weed beds that rob native plants of the light and nutrients they need to survive (Kannenberg and Schmidt, 1998).

In lakes where Eurasian milfoil is left unchecked, well-diversified plant communities can be decimated and replaced by a single species. Eurasian milfoil has the ability to overwinter, giving it a distinct growth advantage over many native plants. The milfoil lies dormant during the winter months instead of dying completely. As spring arrives, the dormant milfoil plants have a head start on many native plants and reach the surface faster, shading out the natives. Eurasian milfoil grows profusely, provides poor fish habitat, inhibits boat navigation, and causes annoyances and even serious health hazards to swimmers and other members of the public wishing to enjoy the lake (Lembi, 1997)

The presence of Eurasian milfoil in Syracuse Lake is alarming because the destructive effects of this plant are well documented. In the past ten years, Syracuse Lake has received very little treatment for aquatic nuisance species. Some property owners along the lake have chosen to chemically treat areas around boat docks on an "as needed" basis. No lake wide management strategy has ever been implemented, and nuisance vegetation treatments have been made principally with contact herbicides that offer temporary relief but little chance of long-term control. Because this lake fosters a diverse plant community with many beneficial native species, great care must be taken not to harm these natives through the action plan. However, Eurasian milfoil now poses a significant threat to the ecosystem of Syracuse Lake, and it must be addressed in the near future.

The ecosystem of Syracuse Lake is already changing because of the accidental introduction of the zebra mussel. These invaders are extremely efficient filter feeders. They remove phytoplankton, zooplankton, and particulate matter from the water column, while decreasing the overall primary productivity of the lake (Kalff, 2002). Because of these characteristics, zebra mussels can greatly increase water clarity. This means that plants can grow at greater depths, because much more light is available throughout the water column. As water clarity in Syracuse Lake increases with the zebra mussel population, it is of utmost importance that newly available habitat is filled by beneficial, native plants and not destructive Eurasian milfoil.

Unfortunately, Eurasian milfoil is not the only invader threatening the ecosystem of Syracuse Lake. The presence of purple loosestrife in the wetlands bordering the lake is equally dangerous. Only 10% of the original wetlands bordering Lake Syracuse remain. The importance and utility of these wetlands are well documented, as are the devastating effects that purple loosestrife can impose on wetland ecosystems (Smith and Smith, 2001). Wetlands may be considered Indiana's most valued and most fragile ecosystems and the importance of protecting them from invasive species cannot be overstated. It is imperative that the purple loosestrife in the wetlands bordering Syracuse Lake receive immediate attention.

Management Goals:

The following management goals have been established by the IDNR for all lakes applying for LARE funding.

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality and is resistant to minor habitat disturbances and invasive species.

2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.

3. Provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

Specific Objectives:

For the major goals of this plan to be met, the following specific steps are extremely important.

1. **Eurasian milfoil must be treated to prevent it from spreading to new areas of the lake.** Since native plants do not compete well with milfoil, containing the spread of milfoil is the best strategy to stop the loss of native plants.

2. **The existing areas affected by the milfoil must be treated to maintain a reasonable level of control**. Reducing the population of Eurasian milfoil in areas where it has already gained a foothold will provide multiple benefits. Recreational activities like swimming, fishing, and boating will all be enhanced by reducing the Eurasian milfoil population. It is also important to note that reducing existing beds of milfoil may provide an opportunity for native plants to reclaim areas where they have been excluded for years. The hope is that the beneficial native plants will gradually replace the invasive milfoil.

3. **Purple Loosestrife must be eradicated if possible**. This will protect the native plants growing in the wetland areas.

4. **Reconnaissance surveys should be conducted to evaluate the effectiveness of the management plan.** This management plan will focus on stopping the spread of these invaders, while reducing the amount of yearly maintenance needed to keep the Eurasian milfoil and the purple loosestrife in check.

Watershed and Water Body Characteristics

Syracuse Lake, located in northern Kosciusko County, has 414 surface acres with a maximum depth of 34 feet and an average depth of 13 feet (Tyllia, 2000). Although no recent diagnostic studies have been completed describing the watershed, the area around the lake is subject to some agricultural use, and its close proximity to the town of Syracuse makes runoff from municipal activities a concern.

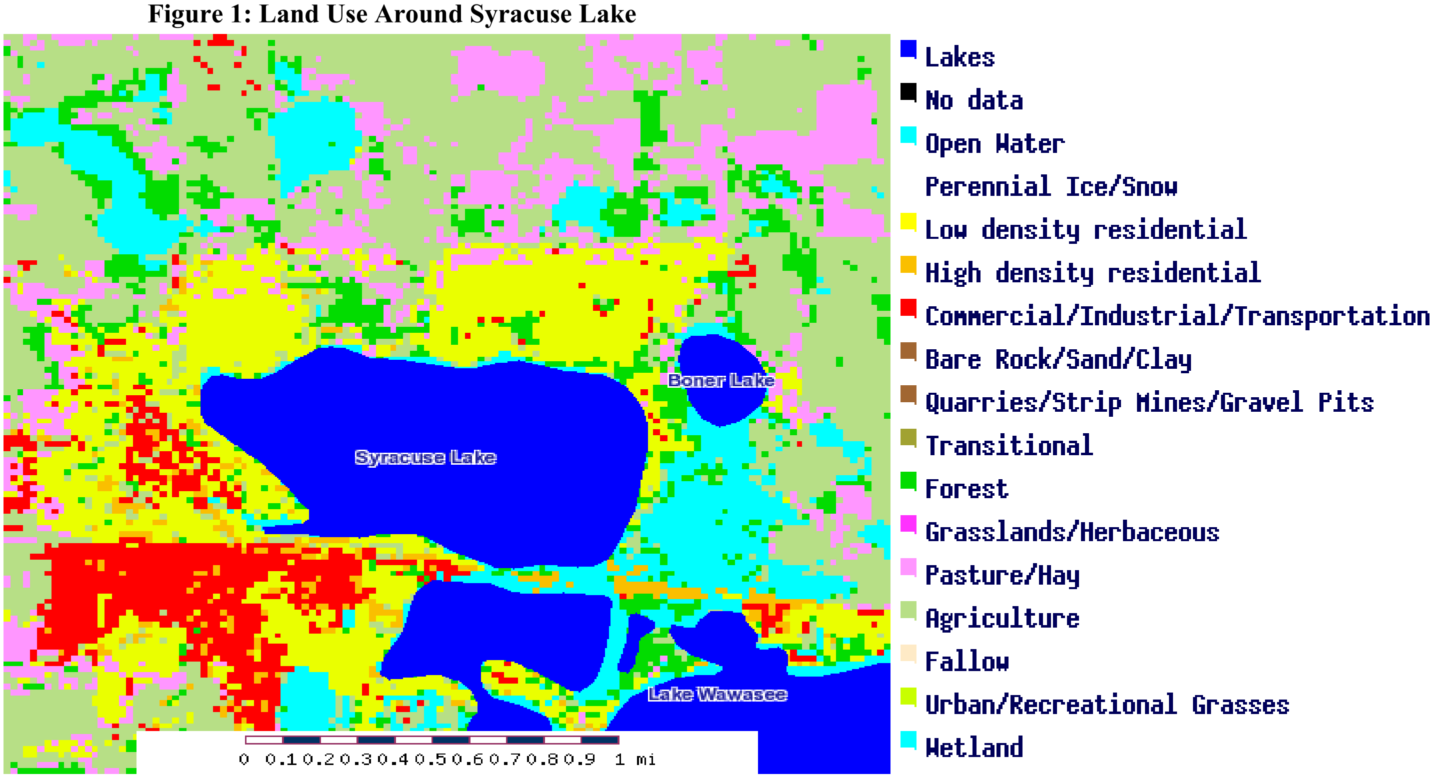
Water quality is considered relatively good in Syracuse Lake when compared to many Indiana lakes. Secchi disk readings average about 9.5 feet and clarity has increased due to zebra mussels. The bottom is a mix of muck, sand, and marl. Aquatic plant growth is abundant in some shallow areas of the lake, depending on the bottom composition. Significant weed beds form throughout the southeast end of the lake over numerous shallow flats and submerged humps. The northwest portion of the lake features a shallow shelf that extends out from the shoreline to about 10 feet of water before dropping abruptly to 25 feet of water. Significant milfoil beds ring the northwest section of the lake along this drop off in about 10 feet of water.

The Indiana Department of Natural Resources has taken actions to help protect the water shed and the ecosystem of Syracuse Lake. An ecological zone has been established in the southeast portion of the lake in order to protect fragile habitat. The ecological zone prohibits boats from traveling above idle speed. It is feared that heavy wave action caused by fast moving boats will damage emergent marsh vegetation, as well as submersed plants. A shallow peninsula that extends into open water from the southeast corner of the lake possesses a large stump field submersed just below the surface of the water. This no wake zone will help protect watercraft and skiers from this underwater hazard, especially during times of reduced water clarity.

The IDNR will conduct further vegetation surveys within the ecological zone in the future to determine how the aquatic plant community has changed since the establishment of the ecological zone. Plant biomass, along with species and abundance data will be used to determine if fragile aquatic plant species are making a comeback as a result of decreased disturbance (IDNR, 2001).

This plan is designed to control the aquatic vegetation but it is important to mention some of the characteristics that that affect the lake to have an integrated lake management plan. The following map has been included to show major land uses around Syracuse Lake that have the potential to directly and indirectly affect its ecosystem.

Figure 1: Land Use Around Syracuse Lake



Syracuse Lake Fisheries

The following fisheries survey conducted by The Indiana Department of Natural Resources and took place on July 31, 1985. Data was obtained by using electro-fishing and gill nets to collect, count, measure, and then release fish. A total of 23 species of fish were collected, many of which were valuable game fish (IDNR Fisheries Survey, 1985).

Bluegills dominated the 1985 survey, accounting for 44.3 % of the total fish community. Approximately 28.3 % of the bluegills sampled were six inches long or longer. Bluegill size in Syracuse Lake is considered average to below average when compared with other lakes in the area.

Largemouth bass were also abundant in this survey accounting for 15.5 % of the fish community. However, very few fish were collected that exceeded harvestable size (14 in.) and the largest fish collected were 16.5 inches.

Yellow perch were the third most abundant fish collected in this survey, at 15.2% of the total fish community. Of all perch collected, 162 of them measured between 6 and 8 inches in length and 9 fish between 9 and 11 inches.

Many fish were collected in very small numbers in this survey. The fisheries community is very diverse with many members of the minnow family collected, as well as rough fish such as bowfin and spotted gar. A table summarizing the 1985 fisheries surveys is included below.

Table 1: IDNR Fisheries Survey of Syracuse Lake 7/31/85

Species	Total # Collected	Percentage	Size Range (in.)
Bluegill	552	44.3	1.3-8.1
Largemouth Bass	193	15.5	4.9-16.5
Yellow Perch	189	15.2	3.6-11.3
Redear Sunfish	139	11.2	2.2-10.2
Longnose Gar	27	2.2	26.3-41.5
Brown Bullhead	25	2.0	8.8-15.2
Warmouth	23	1.8	2.2-7.4
Yellow Bullhead	22	1.8	6.4-12.8
Pumpkinseed	16	1.3	2.5-6.5
Black Crappie	13	1.0	4.3-10.2
Lake Chubsucker	9	0.7	4.3-10.2
Rock Bass	7	0.6	5.0-10.2
Longear Sunfish	6	0.5	2.7-8.2
Green Sunfish	6	0.5	3.6-4.8
Northern Pike	4	0.3	23.4-28.3
Grass Pickerel	3	0.2	4.0-9.8
Brook Silverside	3	0.2	1.9-3.8

Golden Shiner	2	0.2	7.8-8.0
Smallmouth Bass	2	0.2	2.8-6.1
Logperch	2	0.2	3.9-4.5
Bowfin	1	0.1	22.3
Spotted Gar	1	0.1	15.1
Bluntnose Minnow	1	0.1	2.6

Present Water Body Uses:

Today, Syracuse Lake is highly valued to many stakeholders for a number of reasons. This lake is relatively large, and has no speed limit, making it very attractive to ski boats, jet skis, and other fast moving forms of recreation. The lake features a public swimming area along the northwest shore that is a favorite destination on hot summer days.

In addition to these activities, Syracuse Lake has an excellent fishery. It harbors many popular game species such as largemouth bass, northern pike, bluegills, black crappies and yellow perch. This lake is especially popular with many largemouth bass and northern pike anglers. These anglers may be opposed to chemical treatment of the lake, because large weed beds concentrate fish. This underscores the importance of public input when making decisions that will affect a large number of stakeholders.

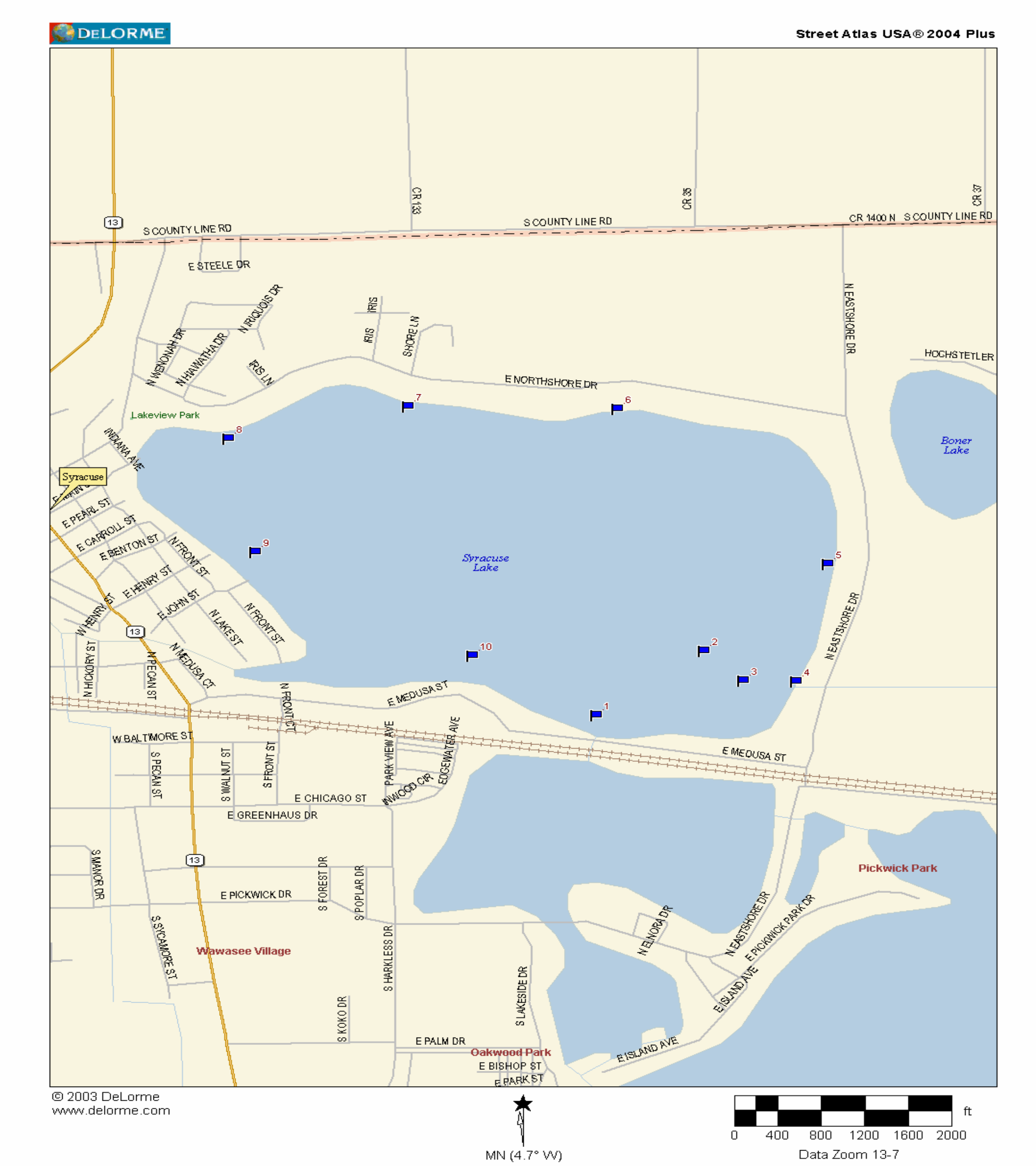
A channel on the south end of the lake connects Syracuse with Lake Wawasee, Indiana's largest natural lake. This increases boat traffic on Syracuse Lake significantly, and adds to the overall utility of the lake.

The public access along the west shore of Lake Syracuse opens this lake to thousands of citizens in the surrounding area. The access site has a fishing pier as well and has room for 40 vehicles with boat trailers (Tyllia, 2000). The residents living on Syracuse share this lake with the general public. Any management practices implemented on this lake will benefit both the lake residents and a large number of stakeholders who visit the lake on a regular basis. The size, location and accessibility of Syracuse Lake make it an excellent site to implement management strategies that will save a valued ecosystem and benefit a large number of people. The public access site can be seen in Figure 3.

Characterization of the Plant Community:

The Tier I and Tier II survey data sheets are included in this report. An important note is that Eurasian water milfoil could occur at greater frequencies and at higher densities than indicated by these surveys. Although little treatment has been done in the past, any chemical treatments prior to the surveys will eliminate milfoil beds that would have otherwise appeared in the Tier I and Tier II plant surveys. Previous chemical applications may result in an underestimation of the true distribution and abundance of Eurasian milfoil in Syracuse Lake. Figure 2 shows the locations of the Tier I major Plant beds.

Figure 2: Tier I Plant Bed Map



Syracuse Lake Tier I Survey Methods

The Tier I reconnaissance survey is designed to identify the major plant beds present in a body of water. This is a qualitative survey designed to give an overview of the aquatic vegetation present in a lake. It identifies and documents problem areas that can be targeted when management practices are implemented. Major submersed plant beds are found visually from a boat. Each bed is given a reference number that is recorded on tier I data sheets. The general location of these beds are recorded on a bathymetric map of the lake, and more precise locations are recorded on Tier I data sheets with the help of a WAAS enabled GPS unit.

When a major plant bed is identified, each species of plant found in that bed is recorded. Canopy ratings are given to each plant bed based on the types of plants present in that bed. The four major types of plants to be identified in this study are as follows: submersed plants, emergent plants, non-rooted floating plants and rooted floating plants. The following scale is used to describe these four types of plants based on the percentage of the plant bed canopy they occupy:

Canopy Rating

1 = <2% of canopy
2 = 2-20%
3 = 21-60
4 = >60% of canopy

In addition to the canopy rating, another abundance rating is given to each individual species found in a particular plant bed. This abundance rating is based on the percentage the entire bed area that species appears to occupy. The scale for this abundance rating is the same as the canopy rating scale. The difference is that this scale identifies the abundance of *individual species* in the bed:

Species Abundance Rating

1 = < 2% of the bed
2 = 2-20%
3 = 21-60%
4 = >60% of the bed

Since this is a visual survey, results are dependent upon the surveyor's ability to locate plants below the water's surface. Tier I surveys are much less effective in lakes with low secchi disk readings. Polarized glasses were used to reduce glare from the sun and enable the surveyors to see more easily into the water. Even with the aid of polarized glasses, the Tier I survey should not be considered an exhaustive survey of aquatic vegetation. The Tier I survey is a tool that helps to provide an overall picture of an aquatic plant community when coupled with the Tier II quantitative survey.

Tier I Major Plant Bed Summary

Plant Bed #1

This plant bed was relatively small with a size of about ¼ acre. Two species were present in this bed: the invasive Eurasian milfoil and the native eelgrass. Both milfoil and eel grass had abundance ratings of 2.

Plant Bed #2
This was a relatively large plant bed with a size of about 2 acres. It was also a fairly diverse plant bed, containing 8 species. Illinois pondweed had an abundance rating of 2, curly leaf pondweed had an abundance rating of 2, Eurasian milfoil had an abundance rating of 2, sago pondweed had a rating of 1, northern milfoil and eelgrass had ratings of 3, stargrass had a rating of 2 and American pondweed had an abundance rating of 1.

Plant Bed #3
This plant bed had a size of approximately ¼ acre and contained 8 species. Illinois pondweed, curly leaf pondweed, sago pondweed, and eel grass all had abundance ratings of 2. Eurasian milfoil, stargrass, American pondweed and chara all had abundance ratings of 3.

Plant Bed #4
This plant bed also had a size of about ¼ acre. It contained 7 species. Illinois pondweed, sago pondweed, northern milfoil, eelgrass, stargrass and chara all had abundance ratings of 2. Naiad had an abundance rating of 3.

Plant Bed #5
This plant bed had a size of 1 acre and contained 4 species. Illinois pondweed, stargrass, and naiad all had abundance ratings of 1 while American pondweed had an abundance rating of 3.

Plant Bed # 6
This plant bed was very small with a size of 1/10 acre and contained only 2 species. Curly leaf pondweed and chara both had abundance ratings of 3.

Plant bed#7
This plant bed was a very long and continuous, with a size of approximately six acres. It contained six plant species. Illinois pondweed, eelgrass, and chara all had abundance ratings of 2. Sago pondweed and stargrass both had abundance ratings of 2, while Eurasian milfoil had an abundance rating of 4.

Plant Bed #8
This plant bed was another extremely large bed with a size of 8 acres. It was also extremely diverse with 10 aquatic plant species present. Sago pondweed, eelgrass, elodea and American pondweed all had abundance ratings of 1. Illinois pondweed, curly leaf pondweed, stargrass, naiad, and chara all had abundance ratings of 2, and Eurasian milfoil had an abundance rating of 4.

Plant Bed #9
This plant bed was located in the northwest portion of the lake, and was the largest bed found, at 12 acres in size. Seven species of plants were contained in this bed. Illinois pondweed, curly leaf pondweed, eelgrass, and stargrass all had abundance ratings of 1. Chara and sago pondweed had abundance ratings of 2, and Eurasian milfoil was the dominant species once again, with a rating of 4.

Plant Bed #10
Plant bed number ten was only ¼ acre and contained 5 species. Curly leaf pondweed, sago pondweed, and northern milfoil all had abundance ratings of 1. Chara had an abundance rating of 2, and Eurasian milfoil

Tier I Survey Summary

The ten major plant beds identified in Syracuse Lake contained two to ten plant species and covered over 30 acres of the lake. Curley leaf pondweed was the most frequently observed plant in this survey. Curly leaf occurred 8 times with an average abundance of 1.75. Eurasian milfoil occurred 6 times and was had the highest average abundance at 3.5.

The large number of species observed in this survey indicates good plant diversity in Syracuse Lake. Excellent water clarity also allowed surveyors to see these species of plants from the water's surface. Tier I reconnaissance survey results are mirrored by the Tier II quantitative survey results. It is believed that the combined data from the Tier I and Tier II surveys have accurately described the aquatic plant community of Syracuse Lake.

Materials and Methods: Tier II Random Sampling

Summary

A Tier II quantitative survey of Syracuse Lake was conducted on August 19, 2004. The purpose of this survey was to document the distribution and abundance of submersed and floating-leaved aquatic vegetation throughout the lake (IDNR, 2004). A specific number of sample sites were selected based on the amount of surface acreage the lake possessed. Once sample sites were determined, sampling was accomplished using an aquatic vegetation sampling rake constructed according to the guidelines of the 2004 Tier II random sampling procedure manual.

Aquatic vegetation collected at each sample site was sorted according to species, and given a value to represent its abundance at that site. These values were immediately recorded on data sheets distributed by the IDNR. These records were used for data analysis that served to characterize the aquatic vegetation community of Syracuse Lake.

Random Sampling:

The IDNR issued the following chart to help determine the number of sample sites needed to accurately describe the aquatic plant community in a lake.

Table 2: Number of Sample Sites Based on Lake Size

Size of Water body	Number of Sample Sites
1-100 acres	40
101-300 acres	60
Greater than 300 acres	Add 10 sites/100 acres

Based on Syracuse Lake's 414 surface acres, 80 sample sites were needed to accurately describe this plant community. Aerial photographs and bathymetric maps were used to evenly space the 80 sample sites throughout the lake. The littoral zone of the lake was divided into four quadrants of equal length. During the vegetation collection process, an effort was made to collect plants from 20 sites in each quadrant to ensure that the entire littoral zone was surveyed adequately and that random sample sites distributed evenly throughout the lake.

When sampling the littoral zone of the lake, a pattern was used that also helped to ensure an accurate description of the plant community. The littoral zone was divided into three sections based on depth and sample sites alternated between each of these three zones. For example, collection site 1 would be taken in shallow water very close to shore. Collection site 2 would be taken further down the shoreline, but in slightly deeper water. Collection site 3 would be taken further down the shoreline, but in even deeper water, close to the border of the littoral and pelagic (open water) zone. This sampling strategy was recommended by District 3 fisheries biologist Jed Pearson. This strategy not only helps to accurately describe the plants in the littoral zone, but it also aids in determining the maximum depth at which plant can grow in particular lake.

Aquatic Vegetation Sampling Rake

A double-headed garden rake was used to sample aquatic vegetation. This rake design is approved and used by IDNR fisheries biologists in vegetation surveys on many Indiana lakes. It consists of two garden rake heads welded together back to back so that rake teeth are protruding from two sides. The dimensions of the rake are to be 13.5 inches wide with 2.25-inch long teeth spaced 0.75 inches apart (IDNR, 2004).

Each tooth on the rake head is divided into five equal sections and marked accordingly. These marks on the rake teeth are used to estimate the abundance of plant species when they are collected.

A nylon rope is then attached to the rake head. A black permanent marker is used to mark the rope in foot long increments. A red mark is placed every five feet along the rope. This rope is used to measure the depth at each sample site when the rake is lowered to the lake bottom.

GPS and Mapping

A WAAS enabled GPS unit was used to obtain and record the coordinates of each sample site on the lake. A WAAS enabled GPS unit is accurate to within 3 meters and was recommended by aquatic biologist Cecil Rich to obtain maximum accuracy for mapping sample sites. All GPS coordinates were then used to produce computer generated maps of the lake with each sample site labeled on the map. A spreadsheet corresponding to this map is included in this report. The species and abundances at each sample site can be found using the labeled sample sites and the spreadsheet.

Sampling Procedure

A two-person crew accomplished Tier II aquatic vegetation sampling by boat. A crew leader was responsible for driving the boat to each sample site and recording vegetation data on record sheets issued by the IDNR. An assistant was responsible for collecting the aquatic plants using the double-headed rake.

When a sample site was reached, its GPS coordinates were obtained and recorded. The boat was then brought to a complete stop and the double-headed rake was lowered to the bottom of the lake. The boat was held stationary while the water depth at the sample site was obtained by using the marked rope attached to the rake.

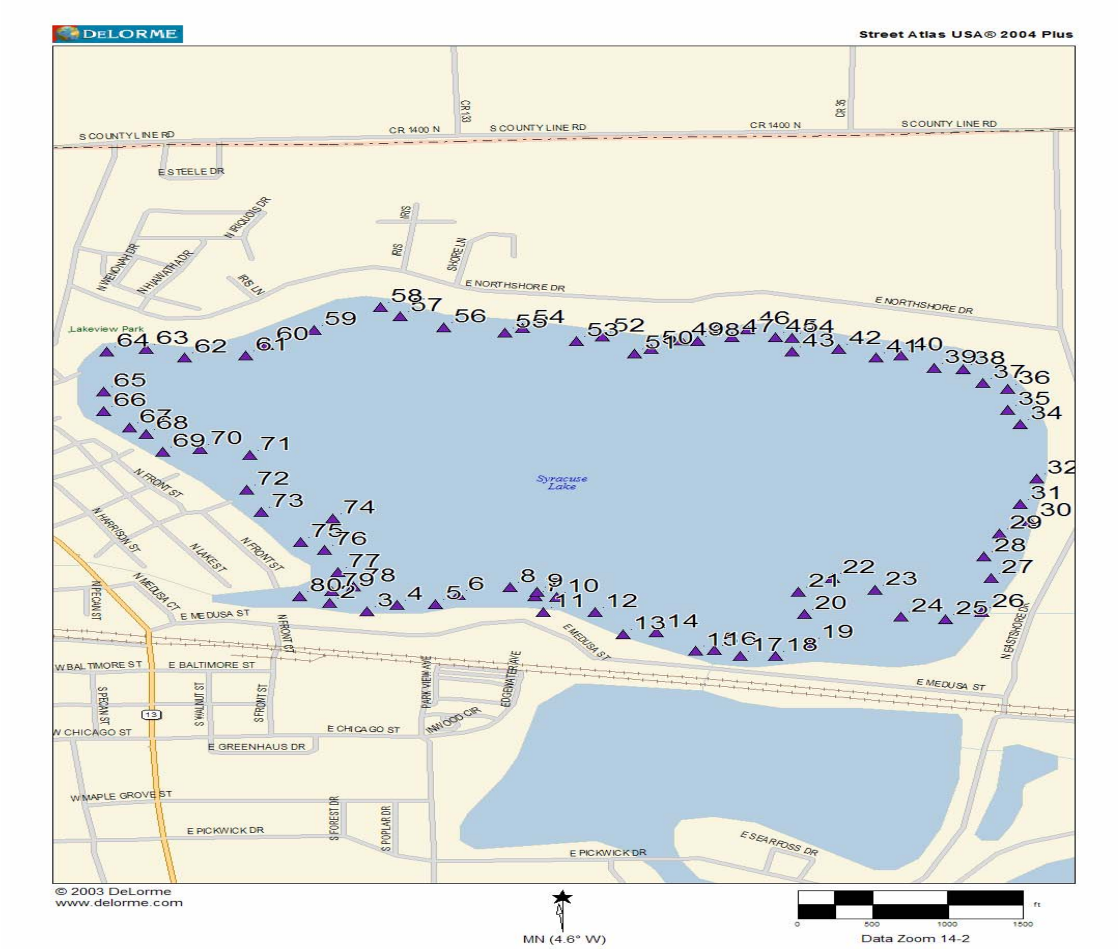
When water depth had been recorded, the crew leader slowly backed the boat away from the rake as the assistant simultaneously let out another ten feet of rope. During this process the rake did not move from the lake bottom.

The rake was pulled from the water after the boat had reached the end of the ten extra feet of rope let out after the depth was recorded. This ensured that the rake was pulled horizontally through the water, giving it a greater chance of collecting weeds than if the rake had been lowered to the bottom and raised vertically. The vegetation caught on the teeth of the rake was then gathered into the boat.

Determining Vegetation Abundance

At each sample site, every plant species collected on the rake was scored according to its abundance. This was accomplished by removing all plants from the rake and sorting them by species. Once all plants had been sorted, they were placed back onto the rake and evenly distributed across the marks on the rake teeth. If a species filled the rake to the first mark on the teeth, that species was given a score of one on the abundance data sheet. If it filled the rake teeth to the second mark, it was given a score of two, and so on to a maximum abundance of five. In many instances it was not necessary to place each species back onto the rake. Many species would fill the rake completely (an abundance of 5) and some species would only have one plant on the rake (an abundance of 1). In addition to abundance scores for individual species, each rake toss was given an overall abundance score, describing how much total vegetation was collected on the rake.

Figure 3: All Tier II Sample Sites



Syracuse Lake Tier II Survey Summary

August 19, 2004

Total # of sites: 80

Total # of Species: 11

<u>Species List</u>:

Chara	Coontail
Northern Milfoil	Sago Pondweed
Eurasian Milfoil	Naiad
Illinois Pondweed	American Pondweed
Eel Grass	Stargrass
Curly Leaf Pondweed	

Table 3: Tier II Survey Data Summarized

Species	# of Sites Present Out of 80 total sites	Average Abundance
Chara	60	2.17
Eurasian Milfoil	31	2.19
Illinois Pondweed	24	1.13
Northern Milfoil	13	1.46
Eel Grass	12	1.17
Curly Leaf Pondweed	11	1.09
Coontail	10	1.00
Sago Pondweed	9	1.00
Naiad	7	1.14
American Pondweed	4	1.25
Star Grass	2	3.00

Secchi depth was taken prior to the survey and determined to be approximately 10.0 feet. A total of eleven species of aquatic plants were collected during the Tier II survey. Of these species, two of them (Eurasian milfoil and curly leaf pondweed) were exotic species. The average number of total species collected at each sample site was 2.79, while the average number of native species collected at each site was 1.89. The species diversity index for Syracuse Lake was 0.83 while the native plant diversity index was 0.75. Average rake density was 3.16 while average rake diversity was 0.76. The diversity index of native plants collected on the rake was 0.60.

Chara and Eurasian milfoil had the highest average densities at 2.48 and 2.40 respectively, while chara had the greatest relative density at 1.87. The most dominant plant in this survey was chara with a dominance index of 37.3 followed by Eurasian milfoil with a dominance index of 17.9. The next most dominant plant was the invasive curly leaf pondweed with a dominance index of 10.1.

The following table describes the plant community of Syracuse Lake using a data analysis program developed by Jason Doll of the IDNR. Common statistical tests and diversity indices used in vegetative surveys are included.

Table 4: Tier II Data Analysis

Occurrence and Abundance of Submersed Aquatic Plants

Date:	8/14/04	Littoral sites with plants:	72	Species diversity:	0.84
Littoral depth (ft):	10.0	Number of species:	11	Native diversity:	0.76
Littoral sites:	75	Maximum species/site:	7	Rake diversity:	0.77
Total sites:	80	Mean number species/site:	2.76	Native rake diversity:	0.63
Secchi:	10.0	Mean native species/site:	1.92	*Mean rake score:	1.60

Common Name	Site frequency	Relative density	Mean density	Dominance
American Pondweed	14.7	0.16	1.09	3.2
Chara	77.3	1.87	2.41	37.3
Coontail	5.3	0.07	1.25	1.3
Curly-leaf Pondweed	42.7	0.51	1.19	10.1
Eel Grass	9.3	0.11	1.14	2.1
Eurasian Watermilfoil	33.3	0.89	2.68	17.9
Illinois Pondweed	30.7	0.35	1.13	6.9
Sago Pondweed	12.0	0.12	1.00	2.4
Native Watermilfoil	13.3	0.28	2.10	5.6
Waterstargrass	9.3	0.13	1.43	2.7
Naiad sp	9.3	0.11	1.14	2.1

Species Diversity and Species Dominance

Two of the most important values in Table 5 are the diversity indices and the species dominance. A species diversity index is actually measured as a value of uncertainty (H). If a species is chosen at random from a collection containing a certain number of species, the diversity index (H) is the probability that the chosen species will be different from the previous random selection. The diversity index (H) will always be between 0 and 1. The higher the H value, the more likely it is that the next species chosen from the collection at random will be different from the previous selection (Smith, 2001). This index is dependent upon species richness and species evenness, meaning that species diversity is a function of how many different species are present and how evenly they are spread throughout the ecosystem.

Species dominance is dependent upon how many times a species occurs, and its relative coverage area or biomass within the system. In this survey, the abundance rating given to each species at each sample site was used to determine dominance. The dominance of a particular species in this Tier II survey increases as its site frequency and relative abundance increase.

Threatened and Endangered Species

No threatened or endangered species were found during the Tier I or the Tier II survey. Controlling the Eurasian milfoil will help to maintain a diverse ecosystem with high species richness. The excellent water quality of this lake is conducive to fragile plant species, and controlling the milfoil may provide a better opportunity for threatened plants to gain a foothold in this body of water.

The following maps indicate the distribution of abundance of dominant plant species found in Syracuse Lake. Each circle on the map indicates a sample site where the particular species was collected. The abundance rating given to the species at each sample site it recorded beside the circle.

Figure 4: Sites Where Chara was Collected

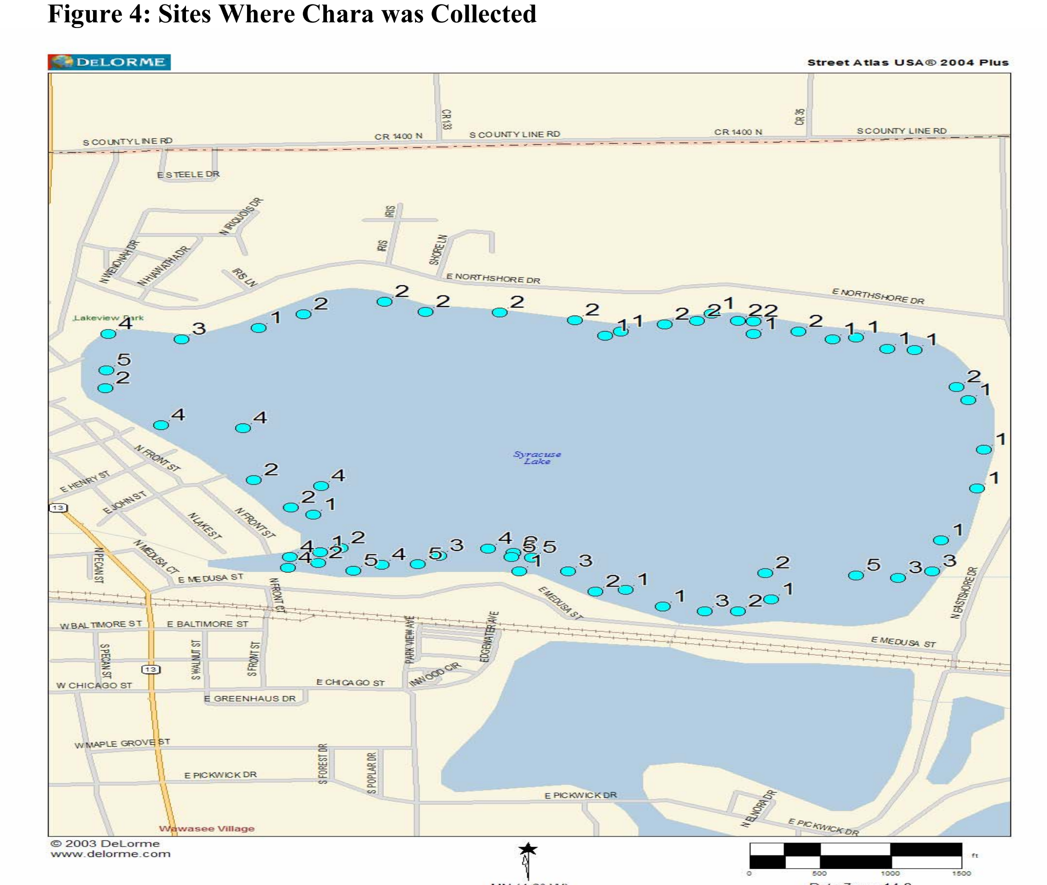
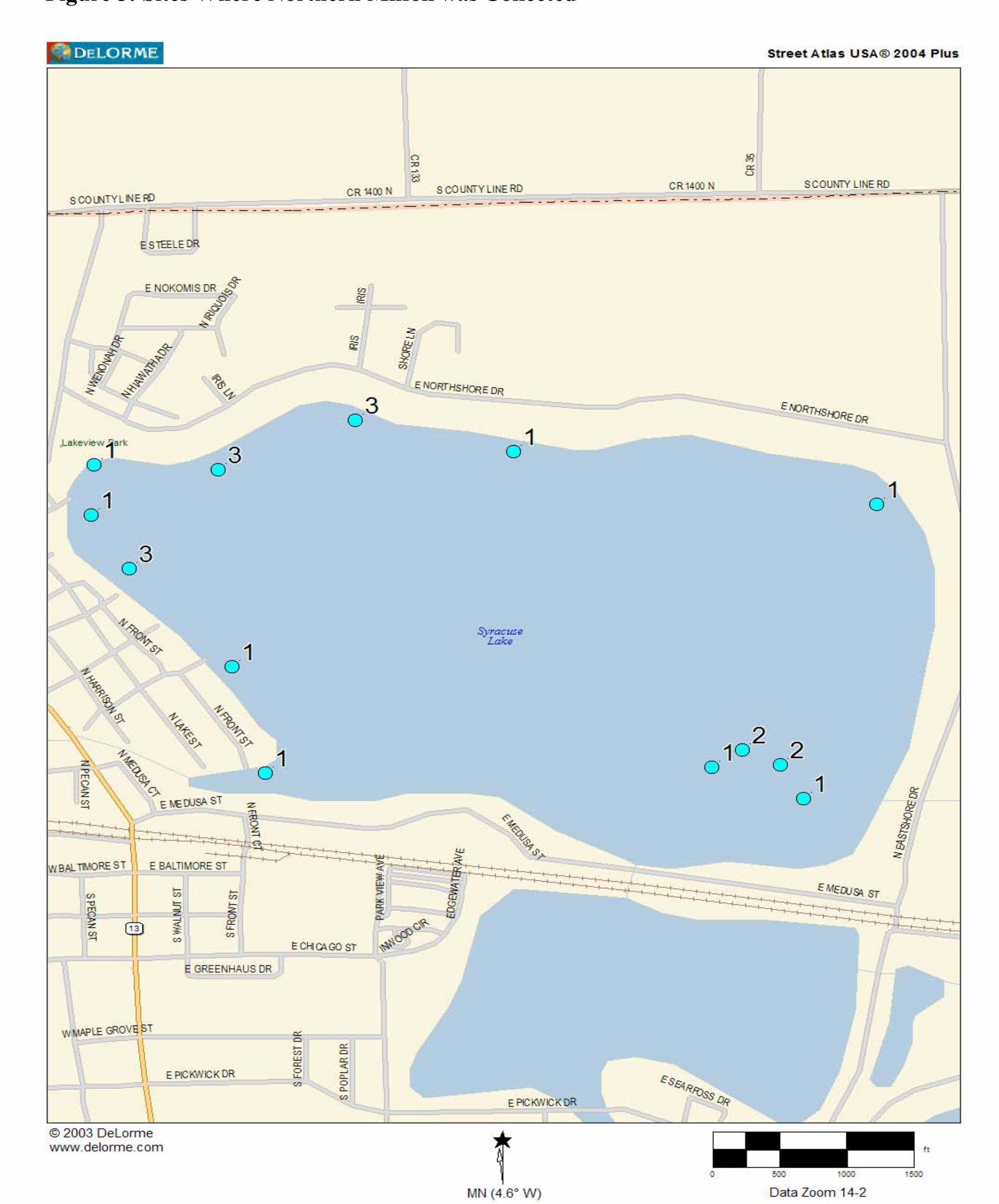
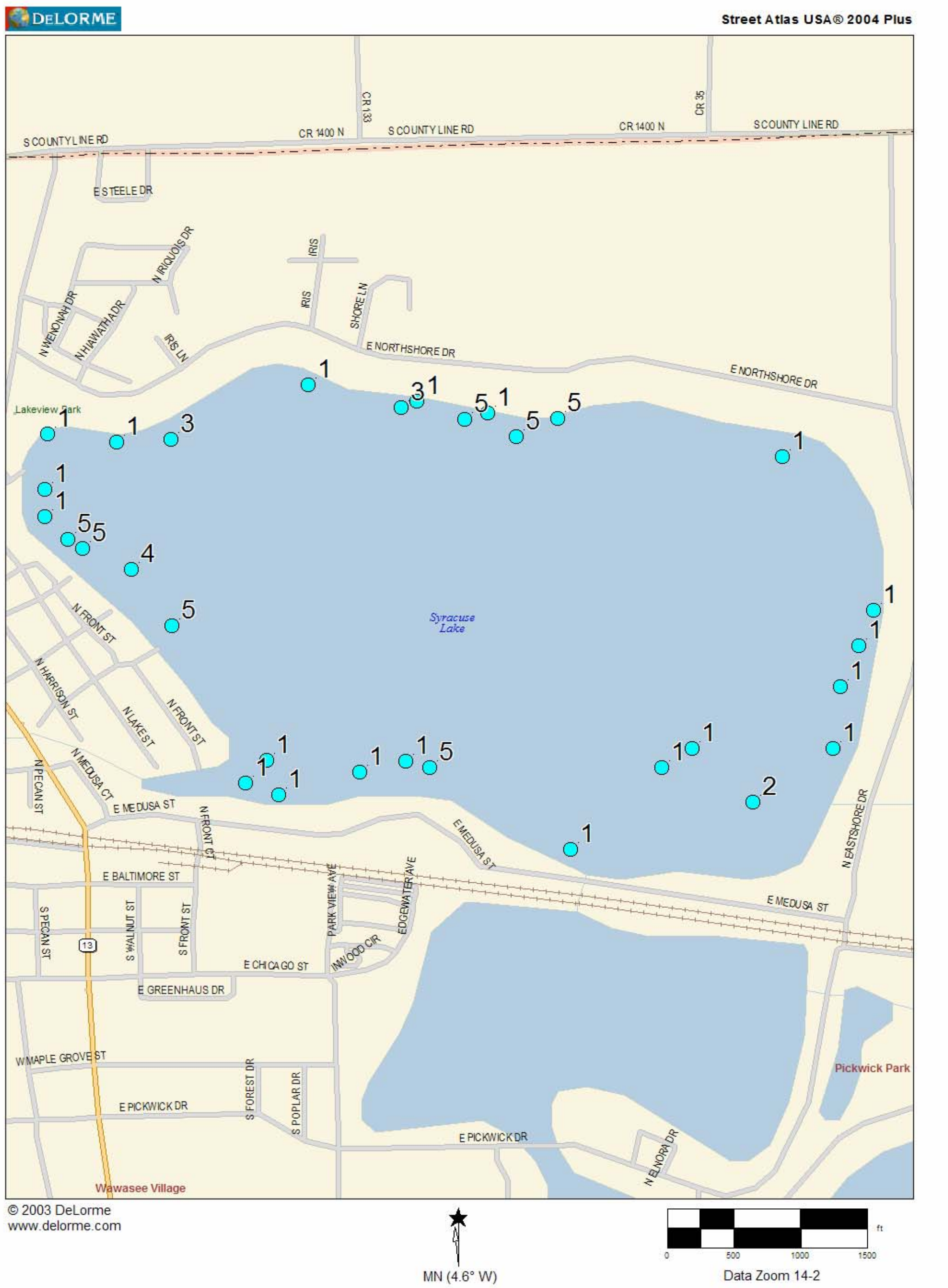


Figure 5: Sites Where Northern Milfoil was Collected



Northern milfoil is a native species that is often harmed by the introduction of Eurasian milfoil. In this survey, northern milfoil was collected at 13 sites and had an average abundance rating of 1.46.

Figure 6: Sites Where Eurasian Milfoil was Collected



Eurasian milfoil was very abundant throughout Syracuse Lake. It was the second most dominant plant in Syracuse Lake, with a dominance rating of 17.9. It was collected at 31 sites and had an average abundance rating of 2.19

Aquatic Plant Management Alternatives

Syracuse Lake currently has dense beds of Eurasian milfoil in many areas of the lake. Eurasian milfoil is believed to have arrived in North America in the mid 1940's and has spread throughout the east coast to northern Florida and the Midwest. It is present in about 75 % of the areas currently treated by Aquatic Weed Control. Eurasian milfoil spreads by fragmentation and seed dispersal, and it has the ability to over-winter from year to year. Once it is in a lake it generally becomes the dominant plant species because it forms dense canopies which shade out the native, more beneficial plant species below. There is also increasing evidence that mat forming species like Eurasian milfoil and curly leaf pondweed exert significant negative impacts on a broad range of aquatic organisms (Pullman, 1998)

Many management strategies have been used to control Eurasian milfoil in Indiana Lakes. A management strategy should be chosen based on its selectivity of the pest in question. The main goal of this plan is to choose a management option that can control the Eurasian milfoil without causing harm to native plant or fish species.

No Action and Other Alternatives.

If no action is taken, the Eurasian milfoil will only get worse since the milfoil grows by fragmentation. Fragmentation means that if the plant is cut, the fragment has the ability to re-grow. Eurasian milfoil also over-winters as an adult plant so new generations are spawned every season, therefore the Eurasian milfoil beds only become denser if left untreated due to fragmentation and seed production.

Mechanical Harvesting

Mechanical harvesting uses a machine to cut the weeds. These machines pick up the cut weeds but will still leave small fragments that will have the ability to re-grow. Also, after an area is harvested the Eurasian milfoil generally re-grows first causing the native plants to be shaded out again. Mechanical harvesting is also not selective in its control. The harvesting will cut the native plant species as well as the exotics if both are present in the same area. For these reasons, mechanical harvesting is not recommended. Harvesting can be accomplished by individual owners around their dock areas. A lake property owner can legally harvest a 625 square foot area. (25 feet by 25 feet).

Environmental Manipulation

Draw down of the lake level is another way to control the Eurasian milfoil problem. Lower water levels expose the Eurasian milfoil roots to freezing and thawing. However, this plan is not selective and will kill native plants as well. Also, this will cause the Eurasian milfoil to grow in deeper water. A lake draw down is not recommended for Syracuse Lake.

Biological Control

The milfoil weevil is a native North American insect that consumes Eurasian milfoil and northern milfoil. The weevil was discovered after a decline in the Eurasian milfoil population was observed in Brownington Pond, Vermont (Creed and Sheldon, 1993). The milfoil weevil burrows down into the stem of the plant and consumes the tissue of the plant. Holes where the larvae burrow in allow disease to get established and the holes also release the plants' gases causing the plants to lose buoyancy and sink (Creed et. Al. 1992).

The problem with using the milfoil weevil is that they have not yielded consistent results. Why they work in one lake and not another is still not well documented. In 2003 Scribailo and Alix conducted a weevil test on Round Lake in Indiana and found no conclusive evidence that the Eurasian milfoil populations were reduced.

Chemical Control

Aquatic chemicals come in two types. There are contact and systemic herbicides. Systemic herbicides kill the roots of the plants. Examples of systemic herbicides are Sonar and Avast (active ingredient: fluridone), Navigate, Aqua Kleen, DMA4 (active ingredient 2, 4-D) and Renovate (active ingredient: trichlophyr). All of these chemicals are effective in killing the Eurasian milfoil by the roots. Based on the author's experience and other lake managers in the Midwest, whole lake treatments of fluridone are the best at controlling Eurasian water milfoil provided the current population in a lake warrants this type of treatment. Fluridone can be applied at low rates to control the Eurasian milfoil and not control the majority of the native weed species present in the lake.

2, 4-D and trichlophyr are both root control herbicides which have the ability to be used in small areas where Eurasian milfoil is present. If fluridone is used, the whole lake needs to be treated. The major difference between 2, 4-D and trichlophyr is that trichlophyr is showing that it may have the ability to control the Eurasian milfoil in select areas longer than 2,4-D. Please remember that Renovate has only been available for use for the past two seasons. The ability of Renovate to provide more long term control of Eurasian milfoil than 2,4-D in spot treatment situations is still being documented. 2, 4-D is less expensive to use but if trichlophyr continues to show better long term control in treated areas it will be a better investment in the long run.

Contact herbicides are used best to control the majority of the weeds around people's piers and in man-made channels. Contact herbicides are the not the best choice to reduce the Eurasian milfoil problem in Syracuse Lake since they are not selective and do not control the weeds by the roots. Examples of contact herbicides are Reward (active ingredient: piquet), and Aquathal (active ingredient: endothal).

The public's primary concern with the use of chemicals is safety. Every chemical registered for aquatic applications has undergone extensive testing prior to a being delivered to the market. These tests demonstrate that the chemical is safe for the environment and will not have adverse effects on humans or the animal population in a lake when used properly.

Action Plan

Our recommendation is to treat the lake with 2, 4-D for the root control of Eurasian milfoil in sections between Flag number 51 and 73 in Figure number 3. There is also a 10 acre patch in the middle of the east end of the lake that will need to be treated. Although this is not a whole lake treatment, it is important to note that this is a significant increase above the current permitted level of control (2 acres/year). However, this new treatment plan does fall under LARE guidelines and can be submitted for approval.

We are recommending 2, 4-D over trichlophr because the band of Eurasian milfoil is only about 20 feet in width around the section between Flag number 51 and 73 in Figure 3. It is also in deeper water versus on shore. Trichophr can have mixed results in narrow bands in deeper water than 2, 4-D. Since this section is offshore, it may not impede boat traffic as much as some near shore weed beds. However, to maintain biodiversity in the lake, it is important to treat the Eurasian milfoil to stop its spread. The association should also post signs at public access signs to help keep the Eurasian milfoil from getting re-introduced in the lake.

It may be necessary to sample the aquatic vegetation prior to any herbicide treatment. This will help to quantify the amount of Eurasian milfoil in the treated areas, and help to evaluate the overall success of the initial treatments.

Purple Loosestrife Control

Purple loosestrife is an invasive species that will take over wetland areas by out-competing the cattails and lilies in that particular wetland area. The east end of the lake between flags number 21 to 24 has purple loosestrife in that area. It is small area now on the edge of the wetland. Treating now would reduce the potential for it to spread to other areas. Trichophr has the ability to control the Purple loosestrife and not kill the cattails. This application is best done in early August to control the purple loosestrife and kill its roots.

Cost Estimates for Invasive Plant Control in Syracuse Lake

2005

Pretreatment aquatic vegetation survey (required by IDNR)	$1,600.00
Chemically treat 35 acres of Eurasian milfoil in the lake	$7,000.00
August vegetation survey and plan update	$1,600.00
Purple loosestrife herbicide and application costs	$1,500.00

2006

Chemically treat 35 acres of Eurasian milfoil in the lake	$7,000.00
August vegetation survey and action plan update	$1,600.00
Purple loosestrife herbicide and application costs	$1,500.00

2007

Chemically treat areas of Eurasian milfoil re-growth identified by vegetation surveys	$5,000 - $7,000
Purple loosestrife herbicide and application costs	$1500.00

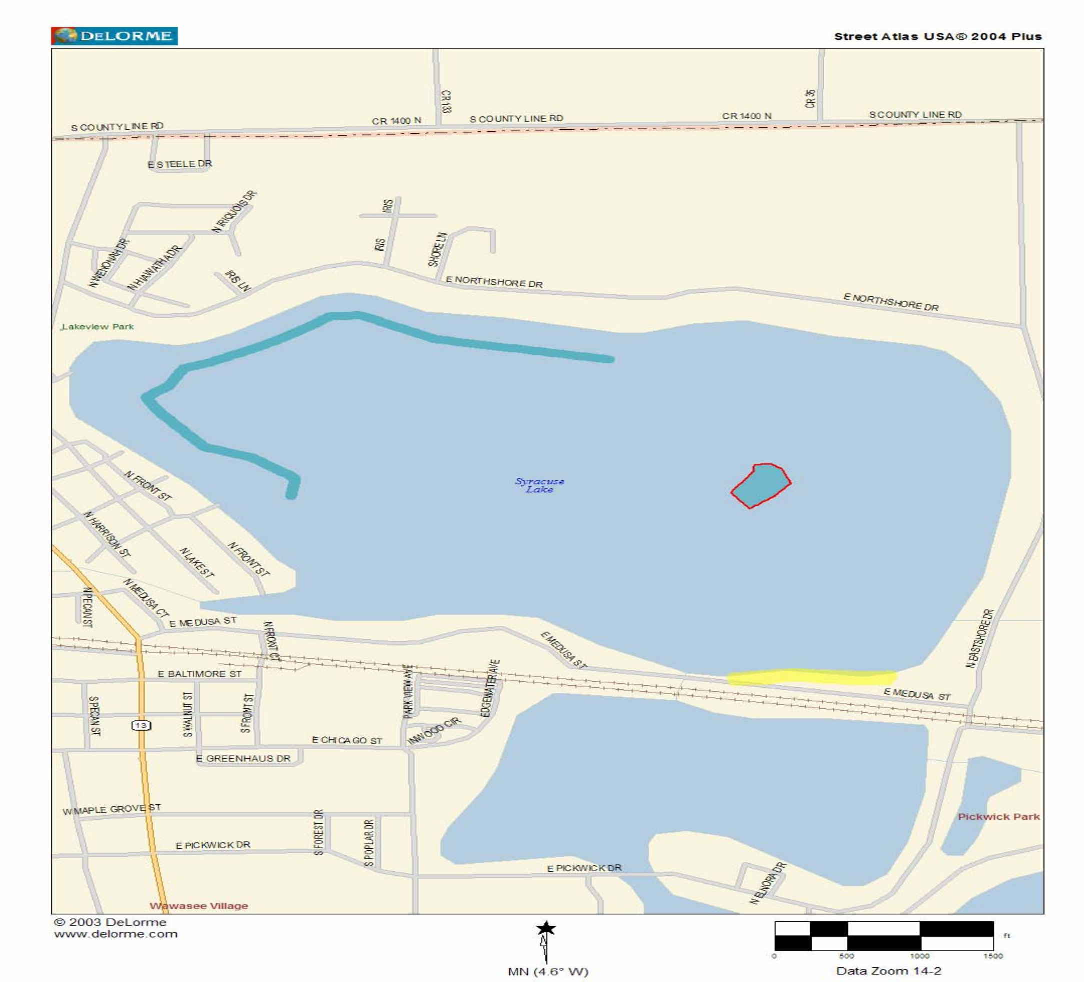
All costs estimates for Syracuse Lake are based upon 2005 herbicide price lists. Further costs will be dependant upon the success of the action plan. It is difficult to speculate on costs beyond 2007. Eurasian milfoil should be readily controlled with these chemical treatments and maintenance costs after 2007 should be reduced. Purple loosestrife control costs will also depend on re-growth and the size of the treatment area in years to come.

Syracuse Lake Treatment Areas

The initial treatment area will cover approximately 35 acres of the lake. These 35 acres will be treated in 2005 and 2006. After 2006, the number of acres needing treatment should decline as Eurasian milfoil beds are eliminated by the chemical treatments. Full eradication is rarely, if ever achieved, but this action plan should significantly reduce the amount of milfoil in the lake and reduce its threat to native plant species.

The following map outlines the proposed treatment areas in Syracuse Lake. Areas shaded green indicate dense patches of Eurasian milfoil that need to be treated. The area shaded yellow at the southeast corner of the lake indicates the portion of the shoreline where purple loosestrife is very prevalent.

Figure 7: Proposed Treatment Areas in Syracuse Lake.



Public Involvement an Education

An informational meeting was held by the Syracuse Lake Association on October 12, 2004. The intent of this meeting was to discuss the problems facing Syracuse Lake, and especially about the threat that Eurasian milfoil poses to both the ecology and the utility of the lake. Potential solutions to these problems were discussed and Jim Donahoe of Aquatic Weed Control offered potential management strategies that could be used to control the Eurasian milfoil and maintain ecological diversity and recreational opportunity at Syracuse Lake. A second meeting will be held in January or February to discuss these plans again.

This information could also be publicized by posting exotic weed species signs at the lake access points. A brief summary of projects made possible by public funding through the LARE program would also be an excellent addition to the annual fishing regulations booklet distributed by the IDNR. Additional information on aquatic management can be found at the following web sites: www.mapms.org www.aquatic.org www.apms.org www.nalms.org.

Monitoring and Evaluation of Plan

After the implementation of the plan, follow-up surveys are essential to monitor the effectiveness of the management activities.

A survey should be conducted in the months following the first chemical application to document any noticeable change in the milfoil's population. Another survey should be conducted the following year to determine if the initial chemical application reduced milfoil abundance from one year to the next.

In the years that follow, additional surveys can be conducted to determine the abundance and distribution of the milfoil. These surveys will begin to describe how the Eurasian milfoil population is reacting to the management strategy over a longer period of time.

Purple loosestrife should also be closely monitored to determine if its distribution and abundance are changing as a result of management practices.

These surveys will provide a basis for evaluation of the action plan and can be presented to the public should the need arise to modify the management strategy. They will also serve to keep the public interested and informed about management practices at Syracuse Lake so they will be motivated and equipped to actively participate in the conservation of the Syracuse Lake ecosystem. The survey results could be addressed at a lake association meeting or through a newsletter.

References

IDNR 2004. Procedure Manual for Surveying Aquatic Vegetation: Tier I Reconnaissance Surveys. IN Department of Natural Resources, Division of Soil Conservation.

IDNR. 2004. Procedure Manual for Surveying Aquatic Vegetation: Tier II Reconnaissance Surveys. IN Department of Natural Resources, Division of Soil Conservation.

IDNR 2001. Lake Wawasee/Syracuse Lake Protected Ecological Zones: Investigation. Indiana Department of Natural Resources, Indianapolis Indiana.

Kalff, J. 2002. Limnology: Inland Water Ecosystems. Prentice Hall. Upper Saddle River, New Jersey. 592 pp.

Kannenburg, J. R., and Schmidt, J. C. 1998. How to Identify and Control Water Weeds and Algae: 5th edition. Applied Biochemists. Milwaukee, Wisconsin. 128pp.

Lembi, C. 1997. Aquatic Pest Control: Category 5. Department of Botany and Plant Pathology: Purdue University. West Lafayette, Indiana. 58pp.

Pearson, J. 2004. A proposed sampling method to assess occurrence, abundance and Distribution of submersed aquatic plants in Indiana lakes. IN Department of Natural Resources. Division of Fish & Wildlife.

Pullman, D.G. 1998. The Lake Association Leaders Aquatic Vegetation Management Guidance Manual.

Scribalio, R. W. Ph.D. & Alix, M. S. 2003. Final Report on the Weevil Release Study for Indiana Lakes. Department of Botany and Plant Pathology. Purdue University. West Lafayette, IN.

Smith, R. L. and Smith, T. M. 2001. Ecology and Field Biology. Addison Wesley Longman, Inc. San Francisco, California. 771 pp.

Stern, K. R. 2000. Introductory Plant Biology. MgGraw Hill. Madison, Wisconsin. 557 pp.

Tyllia, J. 2000. Northeastern Indiana Fishing Map Guide. Superior, Wisconsin. 184 pp.

Appendix A: Aquatic Vegetation of Syracuse Lake

The following appendix was compiled using information found in the 5th edition of How to Identify Water Weeds and Algae, edited by James C. Schmidt and James R. Kannenberg.

1. Chara

Scientific name: *Chara sp.*
Classification: Native to Indiana
Distribution: Extremely common worldwide. Found in hard water.
Presence in Syracuse Lake: Collected at 60 of 80 sample sites

Description: Chara is often mistaken for a vascular plant, but it is actually an advanced form of algae. It can be gray, green or yellow in color and is usually forms extremely dense beds that may cover an entire lake. It can be identified by its distinct musky odor and calcium deposits on the algae's surface make it feel bristly to the touch. It possesses leaf-like structures that are whorled around the hollow stem, and it attaches itself to the lake bottom, although it has no actual roots. It usually grows in shallow, clear water.

2. Eurasian Milfoil

Scientific Name: *Miriophyllum spicatum*

Classification: Exotic in Indiana
Distribution: Common in the Midwest and Eastern U.S. Also spreading along the Pacific coast
Presence in Syracuse Lake: Collected at 31 of the 80 sample sites.

Description: This extremely aggressive and extremely destructive plant has leaves in whorls of 4 around a reddish stalk. This plant grows rapidly and can reach lengths of over 10 feet. This plant has the ability to over winter, meaning it can lie dormant during the winter months instead of dying out completely each year. This gives it a distinct advantage over many native species, as it competes for sunlight in early spring. The dormant milfoil plants reach the surface much faster than the native plants sprouting from the lake bottom. This enables the Eurasian milfoil to shade out other plants and form the dense beds that choke the littoral zone of many lakes.

A reproductive process called fragmentation aids the rapid dispersion of Eurasian milfoil. If a milfoil plant is damaged and some fragments are removed from the macrophyte, each small piece of the plant has the ability to grow roots and create a new milfoil plant. Eurasian milfoil is considered one of the most dangerous aquatic nuisance species because of its ability to rapidly disrupt and destroy lake ecosystems.

3. **Illinois Pondweed**

Scientific name: *Potamogeton illinoensis*
Classification: Native to Indiana
Distribution: Very widespread and very common throughout the U.S
Presence in Syracuse Lake: Collected at 24 of the 80 sample sites.

Description: Illinois pondweed is extremely common in Indiana, especially in the northern third of the state. This leafy weed has leaves with very broad bases that extend three-fourths of the way around the stem. The upper part of its slender stem is usually branched and very leafy.

4. **Eel Grass (Wild Celery)**

Scientific name: *Vallisneria americana*
Classification: Native to Indiana
Distribution: Found from the Great Plains to the East Coast of the U.S.
Presence in Syracuse Lake: Collected at 12 of the 80 sample sites.

Description: Eel grass has tufts of ribbon-like leaves with a horizontal stem embedded in the sediment connecting each tuft. This native plant grows thick weed beds anchored in the mud by roots. These dense beds often shade out other forms of weeds and provide excellent escape cover for small fish. The flowers of this plant are visible in late summer and sit on the top of a coiled structure protruding to the surface. This plant is found in both lakes and river, but is seldom found in stagnant systems. It is considered an extremely valuable plant to aquatic ecosystems.

5. **Curley Leaf Pondweed**

Scientific name: *Potamogeton crispus*
Classification: Exotic to Indiana
Distribution: Found throughout the U.S. in fresh and brackish water
Presence in Syracuse Lake: Collected at 11 of the 80 sample sites.

Description: Curley leaf pondweed usually grows and spreads rapidly in early spring and begins to dies out by midsummer as water temperatures approach 70 degrees Fahrenheit. Curley leaf has extremely thin, membranous leaves arranged alternately on the stem with small teeth-like projections visible along the edge of each leaf. A reproductive spike may be seen protruding from the surface of the water. Curley leaf pondweed may also leave small reproductive structures called turions in the sediment on the lake bottom that can lie dormant throughout the winter and then sprout when spring arrives.

6. **Coontail**

Scientific name: *Ceratophyllum demersum*
Classification: Native to Indiana
Distribution: Common throughout the U.S., usually in hard water.
Presence in Syracuse Lake: Collected at 10 of the 80 sample sites.

Description: Coontail plants are submersed and have no roots, though they appear to be attached to the lake bottom when viewed from above the surface of the water. The free-floating nature of coontail allows it to colonize new areas of a lake quickly, and it often times forms extremely dense weed beds where sufficient light and nutrients are available. Coontail has dark green leaves arranged in whorls around the stem and usually grows in long, bushy strands resembling evergreen trees beneath the surface of the water. Coontail's structure is very similar to Eurasian milfoil but coontail has forked leaves, which distinguishes it from the feather-like projections of milfoil leaves.

7. **Sago Pondweed**

Scientific name: *Potemogeton pectinatus*
Classification: Native to Indiana
Distribution: Found throughout the U.S., Common in the northern 2/3 of IN.
Presence in Syracuse Lake: Collected at 9 of the 80 sample sites.

Description: Sago Pondweed has a bushy appearance with narrow, thread-like leaves that spread out to resemble a fan. Leaves are usually 1/16 of an inch wide and 1 to 6 inches long. Nutlets are formed on a string-like structure and protrude from the surface of the water. While sago pondweed can form dense beds, many times it is found in sparse, loosely distributed arrangements.

8. **Naiad**

Scientific name: *Najas minor* (brittle naiad)
Classification: Native to Indiana
Distribution: Common Throughout the U.S.
Presence in Syracuse Lake: collected at 7 of 80 sample sites

Description: The leaves of naiad plants are usually widest at the base and gradually become thinner near the tip of the leaf. Plants are extremely leafy and appear bush-like when viewed from above the surface of the water. Many species of naiad are very common in this area. Plant structure often resembles chara, but the absence of calcium deposits on the surface of the plant help in identification. The leaves of brittle naiad have multiple spines along the margins that are visible to the naked eye.

9. **American Pondweed**

Scientific name: *Potamogeton americanus*
Classification: Native to Indiana
Distribution: Common throughout the U.S.
Presence in Syracuse Lake: Collected at 4 of the 80 sample sites.

Description: American pondweed can be identified by its oval shaped leaves floating on the top of the water. The base of each leaf tapers to a very long petiole that connects the leaf with the stem of the plant. Plant leaves are arranged alternately on the stem and leaves are usually sparsely scattered.

10. **Water Stargrass**

Scientific Name: *Heterantha dubia*
Classification: Native to Indiana
Distribution: Found throughout the U.S., usually in still water
Presence in Syracuse Lake: Collected at 2 of the 80 sample sites.

Description: Water stargrass has long grass-like stems and leaves. The leaves of this submersed weed have no visible mid-rib, which distinguishes stargrass from many similar species. Bright yellow flowers are often visible on the long, stem-like projections of this plant. When viewed from above the water's surface, stargrass has a thread-like, bushy appearance.

Appendix B: Tier II Survey Data

Table 5: Tier II Data Sheets

Syracuse lake tier II survey

		Plants Present									
	MYSP2	CH?AR	POIL	POPE6	NAFL	VAAM3	MYSI	POCR3		CEDE4	ZODU
Site #	Eur. Milfoil	Chara	Illinois P.W.	Sago	Naiad	Eel Grass	N.milfoil	Curly leaf	Amer.	Coontail	Stargrass
1		4	1								
2	1	2		1							
3	1	5									
4		4									
5		5									
6	1	3					1				
7		5									
8	1	4									
9	5	2		1			1	1			
10		5									
11		1	2	1					2		
12		3	1								
13		2	1						1		
14		1					1				
15	1	1									
16			1				1				
17		3								1	
18		2					2				
19		1					1				
20		2	1					1		1	
21	1		1			1	2	1	1		
22	1		2			2	2		1		
23					2	2					
24	2	5		1	1	1				1	3
25		3					1				
26		3	1		1						
27	1	1									
28											
29	1							1			
30		1			1			1			
31	1						1				
32	1	1			1			2			
33		1	1				1				

34		1	1				1	1		1	
35		2						1			
36											
37			1	1		1	1				
	MYSP2	CH?AR	POIL	POPE6	NAFL	VAAM3		POCR3		CEDE4	ZODU
Site #	Eur. Milfoil	Chara	Illinois P.W.	Sago	Naiad	Eel Grass	N.milfoil	Curly leaf	Amer.	Coontail	Stargrass
38		1			1						
39	1	1	2				2				
40		1	1				1				
41		1					1			1	
42		2	1				1				
43		1					1				
44		2									
45		2					2				
46		1		1			1				
47		2					1			1	
48		2					1				
49	5										
50		1									
51	5	1		1			1	1			
52	1	2		1							
53	5					1				1	
54	1	2					1				
	MYSP2	CH?AR	POIL	POPE6	NAFL	VAAM3		POCR3		CEDE4	ZODU
Site #	Eur. Milfoil	Chara	Illinois P.W.	Sago	Naiad	Eel Grass	N.milfoil	Curly leaf	Amer.	Coontail	Stargrass
56		2	1				2				
57	1	2				3				1	
58								1			3
59		2									
60		1					1				
61	3					3					
62	1	3	1								
63			1				1				
64	1	4	1			1	1	1			
65	1	5				1	1				
66	1	2	1								
67	5										
68	5					3					
69		4									

Site #	Eur. Milfoil	Chara	Illinois P.W.	Sago	Naiad	Eel Grass	N.milfoil	Curly leaf	Amer.	Coontail	Stargrass
70	4		1								
71		4									
72	5			1							
73		2			1	1					
74		4									
75		2	1								
76		1									
77							1			1	
78	1	2									
79		1					1				
80		4	1			1	1				